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STUDIES ON SEED-BORNE MICROFLORA AND THE EFFECT OF SEED TREATMENT OF RICE

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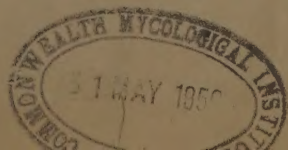
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PRELIMINARY studies on the seed-borne microflora of rice indicated relatively high percentage of rice seed contaminated with various fungi, some of which are usually associated with padi disease. A few isolation tests yielded the following fungi: *Helminthosporium oryzae*, *Nigrospora* spp., *Curvularia* spp., *Cercospora oryzae*, *Piricularia oryzae*, *Fusarium* spp., *Pestalotia oryzae*, *Coniothyrium* spp., and a few others that were not identified. A small percentage of seed gave rise to bacterial colonies but no attempt was made to identify any of these.

After the preliminary isolations, 10 samples of rice seed were obtained from the Division of Botany. All these samples

originated at Telok Chengai Experiment Station, Kedah, and at the time of testing were approximately 8 months old. Two lots of 100 seeds each were taken from each of the 10 varieties, one lot surface sterilized for two minutes in 0.1% HCl solution while the other left unsterilized. The seed was plated on moistened filter paper in Petri plates which were left on a desk at the prevailing temperatures of the laboratory. Readings were taken one week after plating when most of the seed had already germinated.

Since rice seed used in Malaya is ordinarily only about four months old, further samples of more recent seed were



obtained from the Botany Division, and tested in July, 1954. The seed in the latter test varied in age from three to six months. The results of these tests series (a) and series (b) are summarized in Table I.

It is evident from these tests that, although all the seed looked clean and healthy, the percentage of contamination by various fungi ranged from 14 to 100 with an average of 55.3%. Slightly less than one third of this contamination consisted of surface-borne inoculum as shown by the effect of surface sterilization. The remainder was apparently inoculum having penetrated the hulms or even seed and was not affected by surface sterilization.

As could be expected, the abundance of seed-borne microflora varies from year to year and from place to place depending on the weather conditions during maturation and harvesting of the crop. The composition of the microflora also varied between different seed lots. Some lots carried mostly moulds and other innocuous fungi, while others were affected mainly by pathogenic organisms.

The prevalence of various fungi on rice seed indicated that seed treatment with an effective disinfectant might be beneficial and, therefore, several laboratory tests and one field trial were made. In each case two equal lots of seed were counted, one of which was then treated with an organic mercury seed disinfectant at the rate of 1.5 oz. per bushel, and the other left untreated. These were planted in pots except for the one field test which was planted at Pulau Gadong Experiment

Station, Malacca. After the seedlings had developed to the second or third leaf stage, they were pulled out of the soil, counted and separated into a strong and healthy, and a diseased group. A summary of these tests is presented in Table II.

It is evident, from the results of these seed treatment tests, that an increase in the percentage of germination may be obtained with treated seed, particularly in older seed with reduced viability, as well as good control of seed-borne diseases.

Accurate percentage of germination and the percentage of diseased seedlings were not determined in the field test. The plots were examined six weeks after planting and at that time the plots seeded with treated seed were approximately of double the density of stand, and the plants were several inches taller, than the controls. The practical value of seed treatment is thus fairly clearly indicated.

The most important pathogenic padi disease observed in Malaya in 1953-1954 crop year were leaf spots on nursery plants. Fungi inciting these leaf spots, mainly *Helminthosporium*, *Nigrospora*, and *Cercospora* spp. may, to some extent, be carried from season to season on alternate grass hosts but it is very doubtful that this source of inoculum is very important. Seed-borne inoculum, under the common Malayan practice of seeding on the surface of the ground in close-sown nurseries, starts to increase from the day of seeding, through germination and the development of the young plants. Thorough seed treatment with an effective seed disinfectant will very

considerably reduce this source of inoculum and thus enable a development of more sturdy and even growth of plants.

At the prevailing prices of organic mercury seed disinfectant the cost of dressing per bushel of seed would be less than ten cents. One bushel of padi or seed rice weighs approximately 46 lbs. so that cost of seed dressing would amount to less than one cent per acre of transplanted seedlings.

The economic benefit of seed treatment cannot well be evaluated without comparative crop trials, but although Malaya is relatively free from serious diseases of rice, a reduction in the incidence of *Helminthosporium*, and other leaf-spotting diseases which can be controlled, would undoubtedly result in improvement in yields of grain in some regions and seasons, to an amount far in excess of the cost of seed treatment.

Table I

Percentage of rice seed contaminated by various micro-organisms.

Variety Series (a) - (b)	Origin	Unsterilized	Surface Sterilized
(a) Anak Didek 36	Kedah	28	25
Haji Haroun	"	25	18
Mayang Ebos 80	"	23	0
Mayang Tekai 41	"	25	10
Radin Kling	"	43	42
Radin China 4	"	15	8
Radin Siak 34	"	83	40
Radin Goi	"	60	10
Serendah Sungei Dua	"	18	15
Subang Intan 117	"	15	0
(b) Acheh Puteh	Salangor	96	49
G. Tembeling Puteh	Pahang	95	92
Haji Haroun	Kedah	69	56
Kontor	P. Wellesley	60	49
Lentek	Johore	84	76
Machang	Perak	43	22
Mayang Ebos 80	Kedah	44	29
Mayang SaBatil 8	Penang	44	23
Mayang SaGumpal	Kelantan	29	12

Variety Series (a) - (b)	Origin	Unsterilized	Surface Sterilized
Milek Kuning 3	Pahang	93	66
Nachin 11 b	Malacca	25	24
Nalong Telor	Kelantan	89	75
Pe Mi Fun	P. Wellesley	89	50
Radin Che Ali	Perak	100	96
Radin Kling	Kedah	61	31
Reyong 6	Malacca	91	77
Seraup Kechil 36	Perak	49	32
Serendah Kuning	Nagri Sembilan	46	30
Seri Raja	Perak	19	11
Subang Intan 117	Kedah	57	37
Taichung 65	P. Wellesley	58	49
Trengganu	Johore	92	77

Table II

The effect of seed treatment on germination and disease control in rice.

Variety Series (a) - (b)	Untreated		Treated	
	Per cent germination	Per cent seedlings diseased	Per cent germination	Per cent seedlings diseased
(a) Nachin (unselected)	8	75.0	29	3.3
Radin Kling	87	24.1	95	0
Radin Goi	93	3.2	92	0
Radin Siak 34	65	37.5	85	0.5
Siam 29	59	10.0	62	0.7
(b) Acheh Puteh	12	33.3	32	0
G. Tembeling Puteh	92	10.9	98	0
Kontor	95	15.8	100	1.0
Lentek	96	34.4	98	2.0
Machang	96	4.1	100	2.0
Mayang Ebos 80	87	26.4	97	4.1

Variety Series (a) - (b)	Untreated		Treated	
	Per cent germination	Per cent seedlings diseased	Per cent germination	Per cent seedlings diseased
Mayang SaBatil 8	94	8.5	95	2.1
Mayang SaGumpal	96	3.1	97	2.1
Milek Kuning 3	96	8.3	96	2.0
Nachin 11	86	17.4	96	5.2
Nalong Telor	95	14.7	94	4.2
Pe Mi Fun	90	18.9	91	5.5
Radin Che Ali	82	39.0	98	7.1
Reyong 6	59	22.0	80	6.2
Seraup Kechil 36	93	14.0	97	1.0
Serendah Kuning	96	21.9	94	0
Seri Raja	91	15.3	99	2.0
Subang Intan 117	91	19.9	98	2.0
Taichung 65	89	20.2	96	4.1
Trengganu	91	23.0	95	1.0

EFFECT OF LODGING ON YIELD IN RICE

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Cuttack, India

Preliminary experiments were conducted to estimate the loss of yield by lodging in rice and also to find out the effect of ridging the crop on lodging. Three experiments were laid out for these two purposes.

Experiment No. 1. Four strains of the Orissa State with maturity period ranging from 142 to 165 days were each grown in an area of 20 cents and manured with 80 lbs. of nitrogen and 36 lbs. of phosphoric

acid. A few days before the flowering of the crop one half of the area in each was secured against lodging by stretching rope between the lines, the ropes being tied at each end and also in the centre by bamboo stakes, while the other half was left unprotected. The variety T. 1145 lodged at the time of flowering under natural conditions while the other three varieties lodged a fortnight after flowering. The yield recorded from the lodged and non-lodged areas is given below:

Table I

(Yield in lb. per acre)

Varieties	Propped	Non-propped (control)	The percentage of increase in yield of the 'propped' over 'non-propped'	Remarks
T. 1145	2,590	1,750 ¹	48.0	¹ Lodged at flowering.
T. 141	3,423	3,144 ²	8.8	² Lodged a fortnight
T. 90	2,762	2,418 ²	14.2	after flowering.
T. 1242	3,172	3,011 ²	5.3	

The results indicate that the crop which lodged at flowering time suffered a greater loss than those which lodged a fortnight after flowering. It should be made clear that during harvest the plants were carefully harvested so that the shedding of the grain was avoided. The results show that there is a definite loss in yield due to lodging, the greatest amount of loss resulting in the crop lodging at flowering.

Experiment No. 2. The experiment was conducted with four strains growing in bulk plots by staking plants in an area of 3' x 3' in six randomized situations, and comparing them with similar six areas where the crop was not staked. The natural logging of the crop was found to occur a fortnight after flowering in all the varieties and the yield and its components were studied in these samples. The data is given in Table 2.

Table II

Variety	Treatment	Average No. of plants in the sample of 3' x 3'	Total No. of ear- heads in the sample	No. of ear- heads per plant	Grain wt. in grams per plant	Chaff wt. in grams per plant	Grain yield ex- press- ed in %	Chaff wt. ex- pressed in %
BAM. 9	Non-propped	20.33	159.3	7.83	17.56	0.60	100.0	100.0
	Propped	21.83	170.9	7.83	18.71	0.52	106.5	86.7
T. 1242	Non-propped	24.58	125.4	5.10	12.20	0.55	100.0	100.0
	Propped	28.66	140.0	4.90	13.08	0.41	107.2	74.6
T. 141	Non-propped	14.83	129.6	8.74	19.48	1.00	100.0	100.0
	Propped	15.66	129.6	8.29	19.79	0.94	101.5	94.0
T. 90	Non-propped	15.66	162.33	10.30	20.00	0.90	100.0	100.0
	Propped	16.16	174.66	10.80	21.53	0.82	107.7	91.1

The results indicate that the loss in yield was mainly due to greater amount of chaff in the lodged crop. The loss in yield varied from 1 to 7%.

Experiment No. 3. The third experiment was carried out with one variety T. 175 and, 7 weeks after planting, ridging was done

and the experiment was in randomised block of ridged and non-ridged plots replicated six times. It was found that the non-ridged crop lodged completely 10 days after flowering, while the ridged crop did not lodge. The grain yield from these two treatments is given below:

Table III

	<i>Ridged</i>	<i>Non-ridged</i>
Acre yield in lb.	3,519	3,258
As expressed in %	108.0	100.0

It is thus found that the agronomic practice of ridging the crop is useful in preventing lodging.

These experiments are only preliminary and this year a more comprehensive experi-

ment has been planned to find out the loss by lodging at different stages of the crop growth starting with a fortnight before flowering, at flowering and a fortnight afterwards and also to analyse the factors contributing to the reduction in yield.

DISTRIBUTION OF SEED OF IMPROVED RICE VARIETIES

C. Roy Adair¹

Sixteen rice varieties, developed and distributed by the Arkansas, California, Louisiana, and Texas Agricultural Experiment Stations in cooperation with the United States Department of Agriculture, are grown on over 99 percent of the rice acreage in the United States. Most of these varieties

were released during the past 25 years and they replaced the older varieties because of their wide range of adaptation, resistance or at least tolerance to diseases, good yield, grain types that meet the trade demands, and suitability for mechanical harvesting and artificial drying. These 16 varieties and the

¹ Research Agronomist, Field Crops Research Branch, Agricultural Research Service, United States Department of Agriculture.

State where developed are: Zenith, Arkrose, Rexark, and Kamrose in Arkansas; Caloro, Colusa, Calrose and Cody in California; Rexoro, Magnolia, and Sunbonnet in Louisiana; and Texas Patna, Bluebonnet 50, Improved Bluebonnet, Texas Patna 49 and Century Patna 231 in Texas.

Since pure seed is important in maintaining a high quality of milled rice, foundation seed of most of these varieties is grown and distributed each year. Usually this foundation seed is produced at the station where it originated, although some varieties are produced at more than one station and Cody seed is maintained in Missouri rather than in California where it was developed.

Rice harvesting methods in the United States have changed materially during the past 10 years. Formerly the rice was cut with a binder, cured in shocks, and then threshed in a stationary threshing machine. The threshed grain was dry enough to store in sacks or bins when harvested by this method. Now the grain is harvested with a combine when the grain contains from 18 to 24 percent moisture, and it is necessary to dry the grain before it can be stored. In large commercial driers the grain from several farms is usually mixed together to make lots large enough for economical drying and storage. Although the rice varieties are kept separate when dried and stored there is some mixing of varieties because it is difficult to clean the driers, elevators and bins. When the binder-thresher method was used, it was comparatively easy for a farmer to rogue a small

field and clean out his machinery so that he could save his own seed. Now it is difficult for the farmer to save his own seed unless he has a specially designed farm drier or at least bins equipped with forced draft ventilation to dry the grain.

Many rice farmers are now engaged in the production of seed rice to supply the demand for pure, good-quality seed. These growers usually have their own driers and storage facilities which can be cleaned thoroughly if they grow more than one variety so that they produce high quality seed. However, very few seed rice growers are equipped to produce the foundation seed for sowing their fields. The foundation seed is produced on the experiment stations and sold to the seed growers.

The production of foundation or breeders' seed starts with the collection of a large number of typical panicles from a fairly large field containing few admixtures. This will reduce the number of off-type hybrid plants that usually occur in rice grown in close proximity to another variety that flowers at the same time. The panicles are reexamined for off-types, threshed, and the grain from each panicle put in an individual envelope. The grain from each panicle is planted in a 6- to 10-foot row. Each variety is isolated as much as possible by planting only one variety to a block enclosed by levees and alternating with early and late varieties in adjacent blocks. Each row is examined at frequent intervals during the growing season, and off-type rows are eliminated. All rows of a variety are harvested and threshed together. This

"head-row" seed is used to sow increase fields the second year. In some cases the second year increase is grown on the experiment station but in others the "head-row" seed is given to a selected group of farmers to increase. In either case these fields are rogued under the supervision of the experiment station personnel, and the rice is dried, cleaned and bagged at the experiment station. The seed produced

from the second year increase is then distributed to seed growers to produce seed that is called "registered" in some States and "first year certified" in others. Part of the third-year seed is used to produce "second year certified" seed and part is used to produce milling rice.

The amounts of seed of the three grades produced in 1953 are shown in tables 1, 2 and 3.

Table 1. Production of "head-row" seed on rice experiment stations, 1953

Variety	Station				
	Arkansas	California	Louisiana	Texas	Total
	Pounds	Pounds	Pounds	Pounds	Pounds
Zenith	540	—	200	—	740
Arkrose	360	—	—	—	360
Kamrose	225	—	—	—	225
Magnolia	—	—	200	—	200
Sunbonnet	—	—	200	246	446
Rexoro	—	—	—	630	630
Bluebonnet 50	270	—	—	1,509	1,779
Century Patna 231	—	—	—	1,589	1,589
Texas Patna	—	—	—	327	327
Improved Bluebonnet	—	—	—	785	785
Rexark	225	—	—	—	225
Caloro	—	500	—	—	500
Colusa	—	1,000	—	—	1,000
Calrose	—	300	—	—	300
Total					9,106

Table 2. Production of "registered" or "foundation" seed, 1953

Variety	Station				
	Arkansas	California	Louisiana	Texas	Total
	Bags ¹	Bags ¹	Bags ¹	Bags ¹	Bags ¹
Zenith	5,400.0	—	526.0	—	5,926.5
Arkrose	945.0	—	—	—	945.0
Magnolia	—	—	34.0	—	34.0
Sunbonnet	—	—	950.9	—	950.9
Rexoro	—	—	405.0	259.2	664.2
Bluebonnet 50	67.5	—	—	513.5	581.0
Century Patna 231	—	—	—	477.9	477.9
Texas Patna	—	—	—	226.8	226.8
Improved Bluebonnet	—	—	—	452.0	452.0
Rexark	38.2	—	—	—	38.2
Caloro	—	1,400.0	—	—	1,400.0
Calrose	—	90.0	—	—	90.0
Total					14,286.5

¹ Bags of 100 pounds

Table 3. Production of "registered" or "first year certified" seed rice, 1953

Variety	Station			
	Arkansas	California	Louisiana	Texas
	Bags ¹	Bags ¹	Bags ¹	Bags ¹
Zenith	148,875	—	—	3,250
Arkrose	4,000	—	—	—
Bluebonnet 51	25,350	—	—	122,675
Century Patna 231	29,950	—	—	107,525
Bluebonnet	36,125	—	—	—
Improved Bluebonnet	4,575	—	—	1,357
Rexoro	—	—	—	1,325
Texas Patna	—	—	—	5,700
Kamrose	1,125	—	—	—
Caloro	—	171,540	—	—
Calrose	—	3,600	—	—
Total	250,000	175,140	73,550 ²	241,850

¹ Production in 100-pound bags² Figures not available for individual varieties

The methods of distributing the seed to growers are not the same in all states. In all states seed is allocated in such a manner that some goes to all the principal rice-producing areas, but only to growers that have fields that are reasonably free of weeds and facilities for keeping the seed free of mixtures. The allocations are made by a committee made up of representatives of seed growers associations, the experiment

station, and the extension service.

This system of producing and distributing high-quality seed has been in operation only a short time in most of the rice-producing States. We hope that the use of seed that is free of weed seeds and varietal mixtures, together with improved cultural practices, will result in a gradual improvement in the quality of the milling rice produced in the States.

PROGRESS REPORT ON RICE BREEDING AND SEED MULTIPLICATION WORKS IN TAIWAN, 1954

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The rice breeding program in Taiwan has been carried on regularly in eight places: the National Bureau of Agricultural Research, Taiwan Provincial Agricultural Research Institute and six District Agricultural Improvement Stations in Taipei, Hsinchu, Taichung, Tainan, Kaohsiung and Taitung.

The major part of the breeding program is concentrated at the six District Agricultural Improvement Stations since rice production in Taiwan is very much effected by the local factors such as climatic conditions, water supply, and other local characters.

Much effort has been made on the breeding of Ponlai (or Horai) varieties which have higher commercial value. Since 1950 more attention has been given to the

selection of native varieties. But the breeding of upland and round glutinous varieties is limited to a few places where they are of economic importance.

Breeding for disease resistance has also received considerable attention, especially for the blast disease resistance.

Rice seed multiplication and extension work has been carried on by the Provincial Department of Agriculture and Forestry. While the same methods are used in each season, varieties multiplied have been changed from time to time in order to meet local requirements. In early days the emphasis was laid solely on the multiplication and extension of the established varieties of Ponlai rice (including the round glutinous rice). Recently the multiplication

work has been expanded to include native rice since 1950 and upland rice since 1952.

Seed multiplication of Ponlai rice (including round glutinous rice) is carried out in three stages: multiplication of foundation seed, multiplication of stock seed, and multiplication of extention seed. The whole procedure can be completed within one and one-half years as the same variety of Ponlai rice can be grown in both the first

and second crop seasons. Since there are no varieties available for the native and the upland rice, the seed multiplication work has to be carried out in a way somewhat different from that for Ponlai rice by obtaining the original seed from mass selection of certain popular local varieties, and then multiplying them for primary seed and for secondary seed. This will take three years to complete the whole procedure. (See Table 1)

Table 1. Summary of Rice Seed Multiplied in Taiwan, 1954

	Acreage of seed farm (ha.)			Pure seed expected (kg.)		
	1st crop	2nd crop	Total	1st crop	2nd crop	Total
1. Horai rice						
a. Foundation seed	2.15	3.85	6.00	3,228	5,772	9,000
b. Stock seed	61.35	91.96	153.31	147,240	220,680	367,920
c. Extention seed	<u>2,137.50</u>	<u>3,062.50</u>	<u>5,200.00</u>	<u>5,130,000</u>	<u>7,350,000</u>	<u>12,480,000</u>
Total	2,201.00	3,158.31	5,359.31	5,280,468	7,576,452	12,856,920
2. Native rice						
a. Mass selection	—	—	—	2,000	2,980	5,000
b. Primary seed	42.00	29.00	71.00	63,000	43,500	106,500
c. Secondary seed	<u>1,260.00</u>	<u>1,740.00</u>	<u>3,000.00</u>	<u>2,520,000</u>	<u>3,480,000</u>	<u>6,000,000</u>
Total	1,302.00	1,769.00	3,071.00	2,585,020	3,526,480	6,111,500
3. Upland rice						
a. Mass selection	—	—	—	1,957	2,293	4,250
b. Primary seed	14.50	28.00	42.50	14,500	28,000	42,500
c. Secondary seed	<u>290.00</u>	<u>560.00</u>	<u>850.00</u>	<u>290,000</u>	<u>560,000</u>	<u>850,000</u>
Total	304.50	588.00	892.50	306,457	590,293	896,750
Grand Total	3,807.50	5,515.31	9,322.81	8,171,945	11,693,225	19,865,170

FLOATING PADDY IN EAST PAKISTAN

A. Alim, *Economic Botanist,*

and

J.L. Sen, *Assistant Economic Botanist*

East Pakistan has the largest area under floating paddy in the world, amounting to one fourth of its total 20 million acres of land under rice. In low lying areas, this is the only crop grown so that, if it fails, nothing else can be grown as a catch crop. Thus it plays an important role in the rural economy of those areas and rural prosperity depends to a great extent on the success of this crop.

Growth habit. Floating paddy grows with the rise of water and is able to keep its head above it and hence obtains the name. It can grow when submerged in water for a long time. Capacities of growing under water and producing nodal branches and roots are the distinct characteristics of floating paddy. The plants often get entangled with each other during the later stage of growth, and are sometimes uprooted and carried away by waves. These uprooted plants can still grow and produce ears, although the yield may be much reduced. Floating paddy often attains a height of 20 feet.

In East Pakistan there are twenty one local varieties of floating paddy divided into three groups: shallow water paddy, medium water paddy and deep water paddy. They can grow in water levels ranging from 3 to 12 feet deep.

Time of sowing. Floating paddy is sown broadcast in East Pakistan before May

as flood usually occurs in the middle of June. This will give the seedlings at least six weeks to grow and to gain firmness before the advent of flood.

Field preparation. The soil of inundated areas is mostly clayey and as such it hardens and becomes impenetrable on the loss of moisture in the dry months of March and April. Hence for early sowing, the land has to be ploughed up in January, right after the harvest of the previous crop. If this opportunity is missed, cultivators have to wait for monsoon rains, thus delaying the time of sowing and probably causing damage to the crop by the early flood. Paddy straw of the previous harvest left in the field is burnt before ploughing in order to make the land preparation easier and to prevent the incidence of *Ufra*, a nematode disease. As the land remains submerged for more than five months in the growing season, all dry land weeds are automatically killed but aquatic ones are abundant and persistent.

Experiments conducted at the Deep Water Paddy Research Station, Habiganj (Sylhet), have found four ploughings quite sufficient for dry sowing. A light standard plough of iron mould board patented by the Agricultural Engineering Section of the Department of Agriculture, East Bengal, has been found very useful.

Sowing. Floating paddy seeds are sown either dry or wet. For dry sowing, ungerminated seeds are used and covered with earth by ploughing. This will help germination and protect the seeds from birds and rodents. Rains being uncertain in March–April, dry sown seeds often fail to germinate.

For wet–sowing, germinated seeds are broadcast on puddled land, with surplus water drained off before sowing

The practice of seed treatment is not common in East Pakistan. However, floating paddy is fairly free from insect pests and diseases and the need for seed treatment is not felt. The optimum seed rate for dry sowing is 75 lbs. per acre, while that for wet sowing is 100 lbs. per acre.

Manuring. Manuring floating paddy land is not a routine practice. Such land annually gets a deposit of silt, which is considered sufficient for maintaining soil fertility at a steady level. Experiments conducted at the Deep Water Paddy Research Station, Habiganj (Sylhet), have indicated that an application of cowdung or ammonium sulphate can accelerate the growth of seedlings before the advent of

flood, but it has failed to increase appreciably the acre–yield.

Weeds. As stated earlier, dry land weeds are automatically killed by submergence. Among aquatic weeds, water hyacinth is the most noxious in East Pakistan, killing paddy plants simply by crowding them out. The usual practice of prevention is to construct floating bamboo barricades around paddy fields.

Harvesting and yield. Early varieties ripen in September and have to be harvested in water from boats. But these are low yielders, never exceeding 900 lbs. of paddy per acre. They are grown mainly for getting some grains and straw in a period of scarcity for men and work animals. Medium varieties are mostly heavy yielders, about 2,400 lbs. of paddy per acre under favourable conditions.

Remarks. The Deep Water Paddy Research Station, Habiganj (Sylhet), is a registered station of F.A.O. for the maintenance of genetic stocks of floating paddy. Hence requests for seeds and enquiries about its cultivation are frequently received from member countries. It is hoped that this brief note will serve a useful purpose.

PREPARATION OF PADDY LANDS BY MECHANICAL MEANS¹

D. H. Duyf

General Manager

The Gwalior Agriculture Co., Ltd.
India

With our years of experience in the preparation of lands by mechanical means in our extensive farms of 700 acres in Dabra,

M.P., India, I feel confident to give a summary of our views in respect of mechanical puddling.

¹ Prepared for the 4th Session of the International Rice Commission on the request of the Indian Delegation and published here in a condensed form.

Background

In January 1953, a paper was submitted under the title of "Paddy cultivation and preparation of lands by mechanical means" to the conference held in the Agricultural Ministry in New Delhi to deal with farm implements and machinery in India, under the auspices of the Advisory Board of the Indian Council of Agricultural Research. As a result a sub-committee was appointed to deal with my recommendation for a study on land puddling problems and it was also recommended "that the whole subject of rice cultivation, including techniques, implements and their uses, was worthy of special investigation and that the International Rice Commission of FAO be requested to undertake a study of this problem for the benefit of South-East Asia. All relevant data on this subject, including Mr. D.A. Duyf's note and Mr. C.P. Kaju's scheme for investigation of the mechanization of rice crop might be referred to FAO for their information."

While I am awaiting the FAO's findings on this subject, I have continued my experiments on mechanization and increased the area under paddy cultivation. These experiments were conducted with a view to helping small farmers in the village to partly mechanise their farm operations and to see whether such mechanization would be acceptable to them.

In the area near Dabra there was practically no paddy grown before 1945. Our farms, with total area of 7,000 acres, used to grow sugarcane for a sugar-factory. But when it was found that large portions of the

irrigated area after one season of ratoon sugarcane were heavily infested with kans—grass, experiments were then made to grow paddy instead in those areas. We started puddling our land one month before the monsoon but, in spite of ploughing beforehand, we still found it difficult to work with bullocks and ordinary implements on muddy land which was infested with kans weed. The bullocks suffered immensely during the puddling season and it took them a long time to recover fully and some of them died as a result. Still the land could not be prepared before the monsoon set in.

While we were struggling with bullocks, we tried our wheel tractors with a single gang of harrows. To give extra buoyancy to these tractors, an extra wheel rim was added. Sometimes they worked well in fields with a hard pan underneath but in most cases many hours were lost because they got stuck in the mud. It was soon found out that these big wheel tractors were too heavy and the extra wheel rim made them still heavier. Then a trial was made with a small wheel tractor with a Rotavator attached. This Rotavator made the pull heavy for the small tractor and when the tractor got into the mud up to the crank case, all its horse-power was needed to pull it out from the mud and no effective puddling could be done.

Tractors Equipped with Cage-Wheels

In two paddy seasons extensive experiments were made with tractors, with their rear-wheels replaced by so-called "tapered

cage wheels." Subsequently further experiments were made with cage wheels of smaller size attached to the existing rear-wheels. In the rear of the tractor a "perforated steel plank," 9 ft. long, was fixed to level the puddled land and leave behind as excellent paddy seed-bed.

This "plank" can be handled with the hydraulic lift provided with the tractor.

To work land into an ideal "plastic" condition, one has to see to it that there is always enough water in the field to mix with the soil and wash away heavy mud-clods gathered by the rear wheels.

Performance

We have been working with this equipment for two years and now have a fair idea about its cost and performance in an irrigated area of 600 acres under paddy.

The puddling by mechanical means has not really brought about much reduction in cost compared to bullock puddling. However, it must be a great satisfaction to the farmer that he can now puddle the rice fields much more effectively and timely than before.

Comparative Costs

For an area of 600 acres under paddy, it usually requires 32 pairs of draught animals to work on the puddling for 25 days at an average rate of $\frac{3}{4}$ acre per pair per day. In order to make the full use of the growing season and the monsoon, we would like to shorten this period of preparation and do it, say, in 17 days, in which case we would need 47 draught animals, or 5 small tractors and the comparative costs would be as follows:

1. For capital investment

A. 5 tractors @ Rs. 8,000/—	Rs. 40,000 /—
5 sets of implements @ Rs. 1,200 /—	6,000 /—
	<hr/> Rs. 46,000 /—
B. 47 bullocks @ Rs. 1,000 /—	Rs. 47,000 /—
Patella, yoke, ropes etc.	500 /—
	<hr/> Rs. 47,500 /—

2. For operating expenses

<i>Tractors with "Cage-wheels"</i>		<i>Bullocks</i>	
Cost per day			
Oil and lubricant	Rs. 14 / 6 /—	Food	Rs. 2 / 4 /—
Depreciation	8 /— /—	Depreciation	— / 12 /—
Driver's wage	2 / 6 / 4	Driver's wage	1 / 4 /—
Maintenance for tractor	3 / 12 /—	Repairs	— / 4 /—
Maintenance for implements	— / 8 /—		
	<hr/> Rs. 29 /— / 4		<hr/> Rs. 4 / 8 /—

Performance: per day of 8 hours

	5 acres	$\frac{3}{4}$ acre
Cost per acre	Rs. 5/13/—	Rs. 6/—/—

It will be seen that there is not much difference in operating expenses between tractor puddling and bullock puddling. But the tractor puddling has the following advantages:

1. Quicker service,
2. Timely preparation,
3. Less drudgery, and
4. Increased yield due to much better preparation of the land.

Use of Smaller Tractors for Puddling

We also experimented for one year with 2 Japanese walking tractors, with kerosene oil engine of $4\frac{1}{2}$ h.p. This tractor is sold in Japan between Rs. 2,300/— and Rs. 2,600/—.

The puddling was done efficiently in

soils of 6" to 8" deep though the man behind the tractor had to work and learn the art of turning the tractor in a wet field. The comparative operating costs between this tractor and the bullocks in land puddling were worked out as follows:

<i>Walking tractor</i>		<i>Bullocks (one pair)</i>	
Cost per day			
Oil: powerine 3 gall.	4/14/—	Food	Rs. 2/4/—
mobiloil .18"	1/7/—	Depreciation	—/12/—
petrol	—/1/6	Driver's wage	1/4/—
Wage of driver	2/6/4	Repairs	—/4/—
Depreciation	2/5/3		
Maintenance	1/—/—		
	<u>Rs. 12/2/1</u>		<u>Rs. 4/8/—</u>

Performance: per day of 8 hours

	2 acres	$\frac{3}{4}$ acre
Cost per acre	Rs. 6/1/—	Rs. 6/—/—

Again it will be seen that there is hardly any difference in the cost of operation. Although the capital investment for the tractor is twice as much as that for a

good pair of bullocks, the tractor does with one man more than twice the work of a man with a pair of bullocks and does a better job too.

REVIEW OF THE BOOK

“RICE AND CROPS IN ITS ROTATION IN SUBTROPICAL ZONES”¹

Owen L. Dawson²

This book has 611 pages, divided into 7 parts and 46 chapters, dealing with rice culture and other crops in its rotation in subtropical zones. It is an outstanding record of detailed experiments over a period of 40 years in developing Horai or Ponlai and other rice varieties in Taiwan, making possible an impressive demonstration of remarkable achievement in increased rice production in subtropical zones. It will be of great use to those in the rice improvement field as well as in many other crops in many lands.

Several agriculturists and plant breeders acquainted with conditions in the Far East urged Professor Iso to put into book form the results of the work he led on rice improvement in Taiwan, so the value would be best preserved for future use and reference for those in crop improvement work in or related to the region. Professor Iso was unusually well qualified for such a task as he is a thoroughgoing scientist and practical plant breeder. In 1918 and 1928 Dr. Iso was appointed overseas investigator by the Government General of Taiwan and studied plant breeding and biologic statistics at Cornell under Professor Harry H. Love.

He then spent the best part of a life time in applying the findings on Taiwan

(Formosa). As Director of the Agricultural Research Institute and Professor of Taihahu Imperial University, he was chiefly responsible for the remarkable advances in agriculture on Taiwan where he directed a group of hard-working agronomists who gave their ready cooperation in his work.

Professor Iso in his book has presented a multitude of experiments on different phases of rice growing and related crops, which gives valuable results as to the effects of various methods of planting, cultivation and application of fertilizer.

The table of contents shows the richness of the subject matter and where to find the results on many phases of rice experimentation.

Questions relating to the propagation of pure seed, response of varieties and various correlation phenomena in plant breeding and culturing are answered and demonstrated in the results.

Transplanting methods, cultivation techniques and increased yields are recently of increasing interest in other countries of the Far East and in Dr. Iso's book are explained in detail.

There are so many losses in rice after harvest that Chapter IX on drying, processing and storage can be studied with profit.

¹ This book by Eikichi Iso was published by Japan FAO Association, 532 Kamimeguro 8 chome, Meguroku, Tokyo, in 1954, purchasable from the Association at U.S. \$10 a copy.

² The author was for many years Agricultural Attache in the American Embassy in China and more recently FAO Regional Agricultural Economist and Chief of the Agriculture Division of E.C.A.F.E.

The Chapter on Yields sets forth the remarkable results of a 93 percent increase in 45 years in Taiwan, with the possibility of advancing still further.

Those in the region interested in rice increase will be impressed by the outstanding results shown during 30–50 years in Japan and Korea as well as Taiwan. The detailed plant and hill characteristics are of much interest in this connection.

The descriptions of experiments on sweet potatoes, flax, and other fibers, vegetables, peanuts, rape and green manure crops

add greatly to the interest and value of this book for the scientists and economists of the region. These crops are grown in Taiwan in rotation with rice

We are glad to see a book presenting such timely material which we are sure merits wide distribution. The Food and Agriculture Organization Association of Japan is to be commended for sponsoring and publishing this book in such an attractive edition, Official agencies and others who cooperated in the book's preparation are also to be commended.

REVIEW OF THE BOOK "LE RIZ AUX ETATS-UNIS"¹

R. Craps

Agriculture Division
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A Mission composed of seven French research and field technicians spent three months in the U.S.A. during 1951, with a view to studying the American rice-growing methods and techniques for the benefit of rice-growers in France and French overseas territories. The Mission visited rice fields, University Colleges, research and experimental stations, marketing cooperatives and mills in Arkansas, Louisiana, Texas and California.

The Mission found that physical conditions of rice-growing in the U.S.A. differ somewhat from those prevailing in French territories. The crop is not strictly bound to a specific climatic zone: California has a Mediterranean, Arkansas a continental, and the two Southern States a wet sub-tropical climate. On the average paddy soils in the U.S.A. are richer, being only recently utilised alluvial soils; their reaction is generally neutral whereas most French paddy soils are acid.

¹ "Le Riz aux Etats-Unis" Rapport de Mission 1951 par Y. Coyaud, A. Angladette, H. Barcet, L. Caresche, P. Clave, A. Lafforgue, J. Maistre, in *Bulletin Agronomique* No. 10; ed.; Section technique d'agriculture tropicale, Direction de l'agriculture, de l'élevage et des forêts, Ministère de la France d'outre-mer, 45 bis, Avenue de la Belle Gabrielle, Nogent-sur-Marne. Pr. 1200 F. Frs.

From the social standpoint, rice-growing is mostly part of mixed farming, including cotton or grassland and livestock. The farms are large, heavily mechanized, with very little labour. The social and professional standing of the growers is very high as a result of the efficient system of education and extension.

Consequently, cultural practices are very progressive. Irrigation is mostly from surface water and, especially in Arkansas, and somewhat less in Louisiana, from shallow wells; in Arkansas some rice-fields are also irrigated from reservoirs. Irrigation is mostly managed by companies or co-operatives. Drainage planning is the responsibility of public services, such as the Production and Marketing Administration and the Soil Conservation Service; in some areas, private companies or farmers' associations are in charge of it. In crop rotation, rice is very often followed by grass cultivation. Leguminous crops such as soya and lespedeze are often used to provide nitrogen as a supplement to the application of chemical fertilizers.

Breeding work is carried out intensively, with special attention to its usefulness and continuity. The main objectives of breeding are resistance to diseases, adaptation to climate and to mechanical cultivation and harvesting, high yields and improved processing qualities and taste. Seed multiplication on the farm is greatly diminishing owing to combine harvesting and is being more and more reserved for specialized enterprises. Seed certification and trade,

however free within the States, is regulated for interstate and international purposes.

As far as the damage by rice enemies is concerned, it is stated that it is less in the U.S.A. than in French tropical territories. This favourable situation may be ascribed to the geographic and climatic conditions, the integration of the crop into an adequate rotation system, the effectiveness of strict quarantine regulations and, to a great extent, to the strong preventive and control action taken against weeds, diseases, insects, crustaceans and birds which endanger either the crop in the field or the stored grain.

Together with acute labour shortage, the great demand for rice during and after World War II has promoted the rapid development of new machines and equipment for use in every stage of rice-farming. Although efficient, mechanization has, however, created a new problem of paddy drying. Combine harvesting has actually put an end to field drying and the grain in the field often reaches as high as 25 % moisture content, whereas the industry tolerates only 14%. Drying is mainly done by hot air circulation, either as a private or a cooperative enterprise, but seldom on the farm. Storage of paddy in bags is being abandoned because of its cost. The present trend is to use steel cells on an industrial scale or big elevator storages.

The report describes fully rice-processing as well as standardisation and the nutritive value of the product and by-products. A few economic considerations, such as production cost, prices and price support scheme, general and specialized

rice-growers' organizations are subsequently dealt with.

A brief final chapter discusses the

possibilities of adopting some of the methods and techniques thus observed in French overseas rice-growing areas.

INTERNATIONAL TRAINING CENTERS ON SOIL FERTILITY AND RICE BREEDING

Readers will recall that in 1952 FAO organized, in cooperation with the Government of India, two short international courses designed to provide practical training in research for the benefit of technical workers concerned with rice improvement. These two training courses, one in rice breeding and the other in soil fertility, provided junior investigators with unparalleled opportunities for learning the most appropriate and up-to-date research techniques and procedures from some of the world's leading rice authorities. These opportunities were so much appreciated by governments that meetings of the International Rice Commission and its two Working Parties have repeatedly requested FAO to organize these training courses again as soon as possible. Funds to make this possible have recently been made available from the Expanded Technical Assistance Program and the two training centers will be held in India in the latter half of this year. Once again the Government of India has generously offered facilities for the organization of the training courses at active centers of research in that country.

Training Center on Soil Fertility

The second International Training Center on Soil Fertility in relation to rice

growing be held at Himayatsagar Agricultural Station, Hyderabad, India, from 15 July to 18 October 1955. The Director of the Center is to be appointed by the Government of India, and Dr. J.G. Vermaat of FAO will serve as Associate Director. Dr. Vermaat has been on the staff of FAO for the past four years, during which period he has worked in Ceylon and Iran, and he was also Associate Director of the first Training Center on Soil Fertility which was held in Coimbatore, India, in 1952. He has a wide knowledge and understanding of tropical soils.

The Director and Associate Director will be assisted by a staff of eighteen lecturers from India and other rice growing countries. The course of instruction will comprise 120 lectures, with 50 practical periods or field exercises, and will cover the physiology of the mineral nutrients, soil microbiology and plant nutrition, specific chemical and physical requirements of rice, soil chemistry, fertilizer materials (including organic manures and green manuring) and their application, field plot design and statistical analysis. Teams of the participants will lay out fertilizer test plots in the field, as far as possible on problems suggested by them, and will be responsible, after

instruction, for the analysis of the data from these and other experiments. Visits will be arranged to other important centers of soils and fertilizer research, and to areas where various soils and growing conditions can be studied. Seminars will be arranged at which the participants will be invited to lead discussion on problems and work in progress in their own countries.

The course will be limited to thirty participants, and hostel accommodation will be provided at the Himayatsagar Agricultural Station.

Training Center on Rice Breeding.

The second International Training Center on Rice Breeding will again be held at the Central Rice Research Institute, Cuttack, Orissa, India, where trainees will see in actual operation the methods about which they will hear during the lectures. The course will be of three months duration and will commence on 1 September 1955. The Director of the Institute, Dr. N. Parthasarathy, will act as Director of the Training Center, with Dr. L.E. Kirk as Associate Director. Dr. Kirk is a distinguished plant breeder from Canada who, until his recent retirement, was chief of the Plant Production Branch of FAO in Rome. The Director and Associate Director will be assisted by some of the staff of the Institute and by a number of authorities in rice breeding and related topics from other countries and other parts of India, who will come to Cuttack for short periods to lecture in their fields of specialization. The course of instruction will comprise about 120

lectures on the underlying principles of genetics and statistics in relation to breeding and field experimentation, supplemented by practical work in the field and laboratory in the actual procedures involved in the handling of a rice breeding program, the design and lay-out of field trials, and the statistical analysis of experimental data. Visits will be arranged to a number of other important rice research centers and typical rice breeding areas in India for observation of cultural practices and study of the large scale organization of seed multiplication and distribution programs. Seminars will also be arranged at which trainees will be invited to lead discussion on problems and work in progress in their own countries. The course will be limited to 20 trainees and hostel accommodation will be provided at the Institute.

Procedure for enrolment in the Training Centers

By the time notice appears in print governments will have received formal letters from FAO inviting them to submit the names of not more than two candidates for the Training Center on Rice Breeding and not more than three for the Training Center on Soil Fertility. The courses are intended for junior government officers who preferably, following graduation, have had several years of experience with experimental work with rice, thus enabling them to make the best use of the advanced training facilities offered at the respective centers. Non-graduates, provided they have had adequate practical experience, will also be accepted. Nominations will be subject

to approval by FAO. Particular importance is attached by the Organization to the understanding that on their return to their countries, trainees will continue to work either in rice breeding or in soils investigations.

Invitations will be restricted to member governments of the International Rice Commission in the Mediterranean, the Near East, Asia and the Far East areas, and in view of the imminence of the opening dates and the limited number of places available at each of the training centers, nominations should be submitted by governments to FAO in Rome without delay.

Government will be responsible for payment of only the one-way fare for their nominees from their home stations to the training center location, whilst all other expenses, including accommodation, subsis-

tence and the one-way fare for the return journey from the center to home station, will be provided by FAO. These two training centers therefore present governments with an exceptional opportunity of enabling some of their junior technical officers to obtain, at very nominal cost, advanced specialized training which will be of the utmost value to them in the conduct of their future investigations. Such training will in fact be of great value to trainees in fitting them to undertake more independent responsibility for the organization and operation of research programs in their countries. On basis of previous experience it is anticipated that nominations will exceed the number of places available and the attention of all administrative and senior technical officers is therefore particularly directed to the importance of early application on behalf their nominations.

